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AUTHOR Cantwell, Zita M.
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ABSTRACT

Since May 1980, participants in the Early Adolescent Project at Brooklyn College of the City University of New York have studied the early adolescent as a learner in a series of colloquia, discussions, and observations. The purpose of the study has been to develop recommendations for schooling of the early adolescent and for continuing and preprofessional education of teachers of this age group. This document is based on contributions from project participants and information from project activities in combination with a review of selected literature related to the early adolescent as a learner. Current information on psychosocial, neuropsychological, and cognitive characteristics of the early adolescent learner, as well as selected information on the instruction of the early adolescent, is presented. Conclusions and recommendations are made for policies and curricula for the early adolescent and for the education of teachers for this group. Reviews of current writings and discussions are presented for: (1) the biological development of the adolescent; (2) the human brain, hemispheric processes, differences in types and styles of thinking and learning; (3) cognitive development from concrete to formal thinking, metacognition, evaluation of the level of cognitive development, and performance variance; (4) personalized education for the adolescent; (5) management of learning and the transition from concrete to formal thinking; (6) suggested practices for the continuing professional education of teachers of the early adolescent; and (7) preprofessional preparation for teachers of the early adolescent. (JD)

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EARLY ADOLESCENT PROJECT

DEVELOPMENT AT EARLY ADOLESCENCE: IMPLICATIONS FOR CONTINUING

PROFESSIONAL AND PREPROFESSIONAL EDUCATION OF TEACHERS

by

Zita M. Cantwell

Brooklyn College of the City University of New York

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¹ currently Executive Assistant to the Director of Promotions Policy, New York City Board of Education

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Summary

Pierre Fraisse has stated in a recent article that one common goal to be found among the diverse disciplines within the field of psychology is the continuing pursuit of an increasingly complete understanding of the complexity and complementarity of the networks basic to human actions¹. And this is true of the overall conclusion to be drawn from this review of the recent literature related to the early adolescent as a learner; current research reinforces the classical constructs about early adolescent behaviors while adding more depth and breadth to the explanations and descriptions of these constructs. Thus, the review summarizes a wide range of new information about the "whys" of early adolescent behaviors which have significant implications for learning. A careful reading can yield new insights into familiar themes in educational practice.

The purpose for this review of the recent literature on the early adolescent learner has been to present these implications and their research bases, and to provide recommendations which could inform educational policy and decision-making at a time when, with the reestablishment of the 4-year high school, attention is being directed toward making provisions for the grades immediately below, i.e., grades 6, 7, and 8. A summary follows of the conclusions drawn and recommendations made.

1. Personalized Education--meeting individual needs in the classroom by reflecting the learning styles of the students in the instructional environment.

a. Five generalizations about the early adolescent learner reflect the heterogeneity characteristic of this age range: 11 to 14/15-years.

(1) Tremendous variability can be observed in biological development.

One behavioral effect is shortened attention span.

¹Fraisse, P. La psychologie dans le futur. Bulletin de Psychologie, 1980-1981, 34(348), 1-5.

(2) Majority of early adolescents have the competence to move from concrete to formal operational thinking; many are in transition from concrete to formal thinking.

(3) Learning styles vary widely across early adolescence. Cognitive processes of the brain appear to affect cognitive style, a key component of learning style.

(4) Learning is a constructive process which is the responsibility of the learner--the whole person: developed abilities, motives, interests, needs, ...

(5) Information processing strategies--ways of perceiving and coding reality--vary among individuals.

b. Two generalizations about cognitive developmental processes at early adolescence can be made.

(1) While early adolescent learners may have potential to become formal thinkers, they do not automatically make use of the potential; they need to learn and to practice the techniques of formal operational thinking. This learning and performance is dependent upon an adequate base of concrete experiences.

(2) Efficient and effective formal operational thinkers are those who have developed an ability to monitor cognitive activities; that is, who have developed metacognitive skills.

c. Six content-organizational recommendations related to curriculum for the early adolescent learner are made based on the review and generalizations.

(1) Curricula be structured to meet the needs of the holistic as well as the analytic learner.

(2) Curricula be structured so the learner becomes habituated to the use of verbal and visual processing modes.

(3) Curricula be structured to provide varied and appropriate concrete (physical or external) experiences for the learner.

(4) Curricula be structured to provide for continuous process learning, at least in English, mathematics, and science. Continuous process learning is a modified form of nongraded curriculum organization within subject areas.

(5) Curricula be structured to provide for the teaching of the language of the subject areas within the subject area classes.

(6) Curricula be structured to meet the needs and interests of the early adolescent; to foster the development of a motive to achieve in school. Therefore, career education and guidance services should be integral parts of a middle school curriculum.

2. Management of Learning.

Learning is the active constructive task of the learner. Teaching, then, is a management task of organizing and relating new information to learners' previous experiences, stimulating learners' to construct their own representations for what they encounter. Teachers

- a. facilitate and monitor the constructive process of learning, and
- b. possess a quality of flexibility that enables them to provide material relatable to ideas that exist within the particular learner.

3. Project Method: a management approach to facilitate transition from concrete to formal thinking. Projects are

- a. problems or tasks which require exploratory (mental or physical) manipulation.
- b. designed to allow the individual to experience disparity between ideas or events and to plan and execute a solution to the disparity.
- c. to rely heavily on physical--concrete--manipulation in the early stages

of transition from concrete to formal thinking.

- d. designed and managed to encourage increasingly independent and generalizable solutions.
- e. designed to give learners practice in testing their ideas against those of others.

Projects include subtasks which call on cognitive monitoring skills, i.e., give learners practice in the development of metacognitive skills.

4. Practica in the Management of Learning.

- a. Recommendations for continuing professional education of teachers of the early adolescent rest on four assumptions.

- (1) Teachers cannot be expected to complete in-service work of any consequence on their own time.

- (2) Staff development activities should be oriented toward application.

- (3) Teachers and administrators should participate together in staff development activities.

- (4) Provisions should be made for on-the-job supervision of teachers and administrators in staff development courses.

- b. Practica are designed to emphasize a "read/flex"--continual diagnostic--approach to the management of learning. The approach, recognizing the continuously changing nature of the teaching/learning transaction in which the student is the active participant, builds on existing teacher knowledge to direct teachers in the development of continuing evaluation skills which enable the teacher to "read" (or try to understand the student), then "flex" (or adapt management techniques to the needs of the student) who in turn reciprocates.

- c. Six practica in the management of learning.

- (1) Providing for the Analytic and the Holistic Learner in the Classroom.
- (2) Use of Imagery and Verbal Stimuli to Maximize Learning.
- (3) Cognitive Monitoring Strategies for the Learner.
- (4) Improving Skills in the Management of Learning.
- (5) Techniques for Encouraging Transition from Concrete to Formal Thinking.
- (6) Team Teaching for Continuous Progress Learning.

5. Framework for Preprofessional Preparation of Teachers of the Early Adolescent.

a. The teacher of the early adolescent is

- (1) a flexible, warm, good humored individual;
- (2) has a functional understanding of the early adolescent and of the teaching subject; and
- (3) has fluency in techniques of managing instruction.

b. A three-pronged framework includes

- (1) preparation in the subject area to be taught--approximately 30 credits, including some specially developed subject area courses;
- (2) preparation in the professional field--approximately 36 to 40 credits, including courses in early adolescent development, curriculum, methods, evaluation, teaching subject area language, guidance techniques, and an hierarchical set of supervised field experiences--from observation through teaching practicum--integrated with the courses; and
- (3) screening in two areas--language ability and flexibility--for the purpose of personalizing preprofessional preparation.

Introduction

Since May 1980, participants in the Early Adolescent Project have studied the early adolescent as a learner in a series of colloquia, discussions, and observations. The purpose of the study has been to develop recommendations for the schooling of the early adolescent and for the continuing professional education and preprofessional education of teachers of this age group.

This document, Educational Needs of the Early Adolescent, is another of the Project activities. It is based on contributions from Project participants, information from Project activities in combination with a review of selected literature related to the early adolescent as a learner. Current information on psychosocial, neuropsychological, and cognitive characteristics of the early adolescent learner as well as selected information on learning and instruction of the early adolescent are presented. Recommendations--based on the information reviewed--are made for an orientation for curricula offered the early adolescent and for the continuing professional education and preprofessional education of teachers for this group.

The literature selection process was demanding. A great deal of material is available on the early adolescent--the 11 to 14/15-year old--as a developing and maturing individual and as a learner. Much of this material has been analyzed critically and summarized (see, for example, Adelson, 1980; Johnson, 1980; Lipstiz, 1977). Likewise, a great deal of material is available about the education of the early adolescent: curriculum, school structure, methodology, preparation of teachers (see, for example, Eichhorn, 1966; Lounsbury & Vars, 1978). Input from other Project activities and recommendations of the members of the Early Adolescent Project Executive Board contributed to selection criteria.

The Early Adolescent Learner--An Orientation

Several principles about the early adolescent learner underlie what follows.

a. The whole person--developing and growing in a series of environments--is the learner: apperception of self, motivation, achievement orientation, judgmental processes of the environment as well as developed aptitudes and abilities affect cognitive functioning (Bloom, 1976; Garwood & Greenberg, 1978; James, 1980; McEwin et al., 1980; Marjoribanks, 1978; Thornburg, 1980). As Neisser (1963, p. 195) states: There are "... three fundamental and interrelated characteristics of human thought ... (1) Human thinking always takes place in, and contributes to, a cumulative process of growth and development. (2) Human thinking begins in an intimate association with emotions and feelings which is never entirely lost. (3) Almost all human activity, including thinking, serves not one but a multiplicity of motives at the same time."

b. Interpersonal interactions--Kieffer's (1980) social facilitation phenomenon--are important for early adolescent learners (Thornburg et al., 1980; Wade, 1973). Havighurst's (1968, p. 121) developmental tasks for the middle school youngster include (1) organizing knowledge of social and physical reality, (2) learning to work well in the peer group, and (3) becoming an independent person.

c. Heterogeneity--inter and intraindividual differences--is characteristic of groups of middle school age youngsters (Fox, 1977). The great variation within and among individuals calls for flexibility of approach in any instructional/learning situation. And, as Ausubel (1980, p. 227) notes, it is extremely important--again, because of the great variability--"... to distinguish between the phenomenon of development, with its long time frame, and that of learning, which manifests itself in events taking place at a particular time."

An orientation which colors the discussions and recommendations in this document can be expressed through a quotation from an article by Oppenheimer which--although it refers to science--can occur in any subject and can occur for any early adolescent learner--given the flexibility of instructional environment and the recognition that learning is an active cognitive process and that the learner is responsible for learning (Wittrock, 1978a, 1966).

Oppenheimer states that those concerned with learning should direct their attention to the "... studying and practising of the teaching of the sciences in the schools ..., so that first sight shall not repel, and the institutions not resist the natural curiosity and love and joy of the experience, but open it, so that as many as can will have an opportunity to discover some trait of nature, to see with welcome some sure sign of order in nature, with their own hands and their own heads (1963, p. 1145)."

An introductory caution: it is well to keep in mind while reading this document that there are no direct applications of data or findings from either neuroscience or cognitive science to learning or instruction. Research in education and in cognitive science and neuroscience is conducted at separate levels of abstraction. However, there are implications for educational practice which can be drawn from either field--or both combined. This report is concerned with some of these implications.

Learning As Action

Learning is accomplished by learners through their unique actions on the environment (Inhelder & Piaget, 1958). Learning, especially school learning, is a cognitive process which involves construction of meaning from stimuli through verbal or imaginal processing. That is, it is a process in which meanings are inferred by relating stimuli to previous experiences or it involves transfer of structures or techniques or constructs from previous experiences to new tasks or problems (Wittrock 1977, p. 126). The uniqueness of each learner's actions, which leads to the construction of his reality--his world--stems from his singular pattern of (a) biological development (Eichhorn, 1973), (b) cognitive development (Piaget & Inhelder, 1969), and (c) constructive processes of the brain (Wittrock, 1978b).

Therefore, as Wittrock (1974) has stated, learning is a generative process. A process which can produce an indefinitely large pool of knowledge by the application of sets of rules applied to subject areas, constrained by the developed capacities of the learners and the conditions in the proximal and distal environments which impinge upon them. For example, the difference between rote and meaningful instruction is found in the learner's construction of that instruction (Wittrock, 1978b). Thus it follows, any instruction must be so managed that material and tasks and their modes of presentation--the learning environment--are appropriate to the developmental levels and particular styles of learners so that meaningful, constructive learning is possible (Doctorow et al., 1978; Wittrock, 1974, 1977, 1978a, 1978b, 1981; Wittrock et al., 1975).

Given the learner's active role and the teacher's managerial role in the learning process, what are the critical behaviors of the former which interact with the managerial techniques of the latter to facilitate learning?

Data from research on biological development, the brain, and cognitive de-

velopment of the early adolescent learner can have implications for this educational process. Recent research both in neuroscience and cognitive science indicates that the attentional and encoding systems of the brain as well as environmental stimuli are involved directly in learning (Wittrock 1978b, 1981). Research also indicates that for this age group extreme heterogeneity is characteristic of the pace of growth and development.

Biological Development

As both Eichhorn (1980, 1966) and Schoo (1974) note, in any middle school or junior high school classroom one can expect to find biological children, preadolescents, and adolescents. The Boyce Medical Study data show that some students enter and leave the middle school as biological children, others enter as biological children and leave as preadolescents or adolescents, or enter as preadolescents and leave as preadolescents or adolescents, or enter and leave as adolescents (Eichhorn, 1973). Further, the data indicate that the biological maturation rate differs for males and females.

An observable and instructionally significant behavior change which accompanies the biological changes of early adolescence is a shortened attention span. This phenomenon--a transitory offshoot of growth--can be attributed basically to fluctuations in basal metabolism which accompany changes at puberty (Drash, 1960; Eichhorn, 1980; Gatewood & Dilg, 1978).

A parenthesis: These data do not imply that short attention span is a universal phenomenon in early adolescence, that it is manifested similarly by all early adolescents, or that its presence can be attributed entirely to biological changes. But they do imply that one should not be unprepared, in terms of instructional plans, to counteract the effects of shortened attention span.

The Brain

"... man's humanity is vested in his bodily structure and functions, not least, in the activities of his brain (Zangwill, 1976, p. 301)."

While the human brain has characteristic ways of encoding and storing information, individuals differ tremendously in their uses of the attentional and organizational processes of the brain, and--at this age level, especially--in developmental patterns of the brain. Adequate nutrition (Kelin & Pertz, 1978) and a stimulating environment, which allows exercise appropriate to the developmental levels of individual participants (Chall & Mirsky, 1978), are important for brain growth and development. "... the cortex, midbrain, and brainstem actively influence attention, perception, motivation, and the use of memory in constructing meaning from experience. The intentions, dispositions, sets, and memories we bring to a situation influence our understanding of it. ... we learn what we actively construct from being taught, not only or necessarily what the teacher attempts to tell us (Wittrock, 1981, p. 12)."

Chall and Mirsky (1978, pp. 371-375) generalize four themes from current research on the human brain which have strong implications for education.

(a) The central role of environmental stimulation and experience in the growth and development of the brain and in overcoming the effects of intellectual deficiencies or injuries.

(b) The importance of timing.

(c) Certain kinds of training are more important than others.

(d) The importance of cerebral lateralization for the development of cognition and for understanding differences in learning style--especially those attributable to sex, social class, and cultural background.

The fourth and second themes have received considerable attention recently in terms of their implications for education. The following sections briefly

review the themes and their implications, with special reference to the early adolescent.

Hemispheric processing. Currently, educators read about the value of teaching the "right side of the brain"; not necessarily an incorrect statement, but one which has led to an oversimplified conceptualization of hemispheric functioning. Hemispheres are distinguished more by the ways they organize and represent information than by the types of information they represent (Wittrock, 1978b, p. 75). Left and right hemisphere functioning are complimentary to one another and both are essential to effective thinking. While, in general, the left hemisphere is held responsible for ordered, sequential, logical processes --for verbal and linear reasoning, and the right hemisphere responsible for intuitive, imaginative, holistic, visual processes, a considerable body of research suggests that the right hemisphere is capable--perhaps even more efficient than the left--in language processing (Gazzaniga & Hillyard, 1971). Further, memory studies support the existence of dual memory processes which make use of both hemispheres: the left--which uses language and language processes, and the right--which uses visual processes and visual imagery. Research indicates that method of encoding in memory is a function of the nature of the input and the preferred mode of the individual. Encoding appears to operate as follows: easily verbalizable material tends to be stored verbally even if presented visually, easily visualizable material tends to be stored visually even if presented verbally, individual preference is the determining factor for information which is ambiguous. Therefore, interhemispheric communication and cooperation become important parts of most effective memory processing. Hemispheres are able to process stimuli different ways simultaneously and complementarily (Brooks, 1980, 1978; Bull & Wittrock, 1973; Debes, 1974; Grady & Luecke, 1978; Rennels, 1976; Rohwer, 1970; Tomlinson-Keasey et al., 1978).

Male and Female Brain Differences. Research evidence suggests that men and women respond to their environments differently. Some of these differences--which are reported in research from many disciplines--are environmentally induced but others appear founded in human biology. Taking examples which apply directly to the early adolescent, EEG measurements show that when boys are working on problems involving spatial tasks, the right hemisphere is activated consistently, while girls, working on similar tasks, are more likely to activate both hemispheres. Such findings support an hypothesis that spatial ability is more widely dispersed in the female brain. Also, researchers have found that youngsters who reach puberty earlier than normal have brains that are less lateralized, which means that their left and right hemispheres share more tasks. Since females, on the average, reach puberty two years earlier than males, female brains generally can be assumed to be less lateralized. Further, studies have shown that boys and girls respond differently to visual and verbal stimuli (Restak, 1979a, 1979b; Zakariya, 1981).

These findings do not mean that male brains and female brains differ qualitatively; that one group is superior to the other in "brain power." The data do suggest that males and females respond to some types of stimuli differently and process stimuli differently.

Formal Operational Thinking and the Left Hemisphere. Attempts are made to match Piagetian formal operational thought to left hemisphere processing, for example, statements that formal operational thinking is "left hemisphere thinking" or that it is linear, analytic, verbal thinking (see, for example, E. C. Gray, 1980). The types of experimental tasks most widely used for measuring formal operational thinking and the methods for evaluating these tasks are cited frequently as a rationale for the link. However, Piaget noted that these experimental procedures were not the only ways in which formal operations could

be assessed. In point of fact, he stated that formal operational thinking could be evidenced in multivariate behaviors depending on the experience of the individual (Inhelder & Piaget, 1958; Piaget, 1952, 1972; Piaget & Inhelder, 1969). And as Cole (1980) points out, Piaget's theory of cognitive development deals very basically with left and right hemisphere functioning. "The process of equilibration (striving to close open systems) and the process invariants of assimilation (of experience to logical schemes and structures) and continual accommodation (of these logical structures) to a perceived holistic reality are ongoing ... (p. 39)." Development and efficient use of both hemispheres --and cooperation between them both--is required at the early adolescent age for optimal cognitive functioning; for the development of formal operational thinking, an increase in creativity--or the integration of intuition with divergent thinking and evaluation, maximizing memory, self-actualization--including increased skill in interpersonal relationships and establishment of a stronger sense of identity, and mental health (Brooks, 1980, 1978; Botkin et al., 1980; Claycomb, 1978; Hunter, 1978; Olson, 1978; A. Smith, 1976).

Learning Style. Wittrock (1978b) identifies strong educational implications in the probable links between cerebral lateralization and learning style. And, Thies (1979) concludes that learning style is related to brain growth and development. The analytic/relational or global/analytic cognitive styles (R. A. Cohen, 1969; J. K. Davis, 1975), field dependent/field independent cognitive styles (Witkin et al., 1977), male and female differences in behavior (Messer, 1980; Restak, 1979a, 1979b); and verbal/imagery information processing preferences (Paivio, 1971; Tomlinson-Keasey et al., 1978), which appear to be related to lateralization, affect learning style. And they do so developmentally; for example, field independence appears to increase with age irrespective of dependence/independence preference (Witkin et al., 1967).

Learning style has been described by Hunt (1981, 1979) as the amount of structure an individual needs to learn best. Learning style is not synonymous with ability, but can change developmentally along a concrete-abstract continuum (Gregorc, 1979; Hunt, 1981). As elaborated by Keefe (1979a, 1979b), learning style has three dimensions: (a) cognitive style or perceptual modality preference, e.g., Witkin's (1977) field dependence/field independence; (b) affective style which is described by, for example, attention, locus of control, self-actualization; and (c) physiological style as seen, for example, in male/female behavior differences (Restak, 1979a, 1979b), health related behaviors, time.

Timing. Educational implications of timing can be considered from two perspectives: (a) the developmental schedules of specific regions of the brain, and (b) the longitudinal slope of the path toward maturity of the brain.

With respect to the first, MacLean (1978), for example, points out that the development of the emotion of empathy must start early because regions responsible for empathic processes develop early. And a certain amount of research has been concerned with the optimal developmental time for learning a foreign language.

Currently, the second perspective is receiving an amount of discussion in the literature of education. Based on his review, critical analysis, and synthesis of research studies in neuroscience and cognitive science, Epstein (1974a, 1974b, 1978, 1980, 1981) notes that the brain develops in spurts and plateaux, rather than at a continuous rate, to maturity. This developmental characteristic, phrenoblysis, means that arborization, or the growth in complexity of neural networks, occurs periodically within chronological age spans: 2-4, 6-8, 10-12, 14-16. In-between ages, the plateaux, are no- or slow-growth periods; times when no new "software" is being built into the neural networks.

Both a spurt and a plateau occur during the early adolescent years.

Epstein states that during plateau periods, when the individual is functioning essentially with existing neural capacities, educational interventions should not be planned which demand increases in these capacities for their assimilation. Epstein would like educators to match the curriculum content to the cognitive capacities of the students--cognitive capacities considered in terms of brain spurts and plateaux (Cramer, 1981; Epstein, 1981; Epstein & Toepfer, 1977; Horst & Johnson, 1981; Toepfer, 1980, 1977). This is reasonable: not to demand activities beyond the capacities of the learner. However, in the implementation of such an objective, one must be cautious of a direct move from a brain growth plateau (or spurt)/chronological age group conceptualization to an individual learner's level of cognitive development. Especially at the early adolescent age--the period of transition from concrete to formal operational thinking and the period characterized by tremendous inter- and intraindividual variability--extreme caution must be exercised not to confuse learning, the path by which formal operations move from competence to performance, with development, in this instance a neural development which cannot at this time be measured in the individual learner. Concrete operational thinkers may be at a plateau or spurt stage, as may formal operational thinkers.

Cognitive Development

Keating (1980) describes five qualities which characterize adolescent thinking: (a) thinking about possibilities--separating that which is real from that which is possible, (b) thinking through hypotheses, (c) thinking ahead, (d) thinking about thoughts, and (e) thinking beyond limits. Most early adolescents are developing toward these qualities. And it is this condition of developing toward--with its implications of individuality of pace--which provides a significant challenge to the management of learning during the early adolescent years.

Therefore, the sections which follow present brief discussions of the transition from concrete to formal operational thinking, thinking about thinking, and evaluating the level of cognitive development. (See Flavell (1977) and Voyat (1982) for thorough treatments of cognitive development.)

Concrete to Formal Thinking. Using a sample of approximately 10,000 U.K. science students, aged 9 to 16 years, plus a smaller "top" group, Shayer and his associates found that formal thinking was not universally attained by age 14 (Shayer & Wylam, 1978; Shayer et al., 1976). Selected Piagetian tasks and a nonverbal intelligence test--all administered and scored by the classroom teachers--were used as measures of thinking. Based on his findings--only about 30% of the top 20% had attained formal operational thinking by age 14½--Shayer hypothesized that the development of formal operations continues at least into late adolescence.

As conceptualized by Piaget, formal operational thinking is characterized by the (a) ability to think about thought, and (b) reversal of relations between what is real and what is possible, that is, the former becomes subordinated to the latter in thinking. Students who have reached this stage of cognitive development become more introspective; can hold, compare,

and contrast separate thoughts; can know about the processes by which thinking operates, e. g., can recognize they are using a given type of solution for a problem with particular characteristics--an important skill for transfer. Further, students are able to engage in hypothetical thinking, that is, to develop and test hypotheses; for example, to efficiently and effectively troubleshoot a car that will not start (Day, 1981; Elkind, 1980b; Eson & Walmsley, 1980; W. M. Gray & Hoffman, 1976; Ingison, 1973; Inhelder & Piaget, 1953; Keating, 1980, 1975; Keating & Schaefer, 1975; L. K. Miller, 1968; Piaget, 1976, 1972, 1952; Piaget & Inhelder, 1969; Sawyer, 1975; Strahan, 1980; Voyat, 1982, 1973; Webb, 1974).

Piaget's stages describe competence not performance (Day, 1981; Stone & Day, 1980). Although early adolescent learners have potential to become formal thinkers, they do not automatically make use of the potential; they learn to use the potential--and all individuals do not do so necessarily in school-type tasks. Research shows, and Piaget himself suggested, that individuals with no formal schooling can think formally when dealing with a familiar subject (Piaget, 1972; Tulkin & Konner, 1973). At the beginning stages of formal thinking, students may develop the potential differently among subject areas, depending in part on their previous concrete (physical or external) experiences related to the content of a subject area. So that students with a solid background of concrete experiences in mathematics may be able to think at a formal operational level in that subject before they can do so in social studies, where their concrete experiences may have been more limited (Nordland *et al.*, 1974; Stone & Ausubel, 1969). Transition to formal operations is gradual; can be subject to developmental differences across ability, sex, socio-cultural groups; and, especially at the early transitional stage, is not automatically extended--does not generalize--across subject areas. Particular techniques and approaches

for facilitating transition from concrete to formal thinking have been developed by subject area, in addition to those general techniques and approaches suggested (Adelson, 1982; Andriette, 1970; Ball & Sayre, 1972; Barratt, 1975; Bratt, 1980; E. Brown, 1971; S. R. Cohen, 1975; Danner, 1977; Ekwell et al., 1980; Elkind, 1980b; Godbold & Fournet, 1977; Karplus, 1977; Karplus et al., 1980; A. E. Lawson & Wollman, 1980, 1976; Levine & Linn, 1976; Linn, 1981; Linn & Levine, 1976; Lupfer, 1976; Malin, 1979; Renner & Phillips, 1980; Schneider & Renner, 1980; Smock et al., 1968; Voss & Novak, 1980; Yeotis & Hostika, 1980).

Since the early adolescent youngster can be in transition from concrete to formal operational thinking, the following four points related to the development of formal operations are important to consider. Sample instructional activities are used to illustrate each point. However, developmental transition cannot be equated to learning. As Voyat (1973, p. 167) states, development deals with a change of paradigms of thought while learning takes place within a particular paradigm. In application, instructional tasks similar to these samples would be extended to the developmental levels of the learners for the purpose of creating an instructional environment which would permit learners to participate at their present cognitive levels but at the same time interact with peers at other cognitive levels.

(a) Formal thought has its base in appropriate concrete (physical or external) experiences related to subject areas. Individuals internalize representative copies of external events (concrete thinking) so that they eventually are capable of internal representational knowing (formal thinking) (Inhelder & Piaget, 1958). To work successfully through projects (i.e., problems or tasks) requiring hypothetical or formal thinking, students must have stores of principles, concepts, problem solving strategies from which to select.

These pools of knowledge and understanding develop from familiarity with the concrete (physical or external) reality of the subject areas. Therefore, students need to have--or have had--adequate, appropriate concrete (physical or external) experiences in subject areas if they are to move to formal thinking in any of these areas. The need for such experiences may vary from subject to subject for individual students, depending on previous experiences. For example, in mathematics or science, an understanding of what measured data are can be developed by making numbers of different kinds of measurements, comparing them, and consciously generating a construct of "measured data."

(b) Language becomes the tool of thought for formal thinking (Inhelder & Piaget, 1958). Language becomes the medium to stimulate and express thinking. Linguistic symbols replace concrete (physical or external) objects in thought and immediate concrete referents are no longer necessary for thinking. Therefore, students need to know the languages of the subject areas. They also need to be able to use such languages with precision, for example, it is easier to change an opponent's viewpoint when the argument is well articulated than when the debate is against unanalyzed assumptions vaguely expressed. For example, the vocabulary of "social stratification" in social studies can be built using students' experiences; or precision in the use of vocabulary can be built through short oral or written exercises evaluated by peers.

A parenthesis: "Language becomes the tool of thought" contains a singularly knotty challenge to managers of learning. The statement is axiomatic: learners need to be able to handle the common language of thinking and the language of the subject areas. But questions arise about interrelationships among intervention strategies, cognitive processes of the brain, and development of language fluency; questions related to the variability--including motivational variability--among learners: For example, variability in preferred mode of

encoding stimuli--visual or verbal, or preferred cognitive content--figural, symbolic, or semantic. Or, consider the instance of the youngster, usually male, who when asked to write a problem solution on the board and then explain it can complete the former task handily but not the latter; "I can't put it into words" can be related to factors in neural development (Restak, 1979a, 1979b; Treagust, 1980).

(c) Formal thought develops through exploratory manipulations (mental or physical), that is, through practice in developing and testing hypotheses. Certain cognitive abilities, such as capacities to understand and use proportion and correlation, and operations of disjunction, implication, and conclusion are particular to formal thinking. But, the abilities become effective in thinking only through exercise, that is, by completing projects (tasks or problems), within subject areas, which require exploratory (mental or physical) manipulation (Gruber, 1973).

Projects should be graded in difficulty level and in complexity (complexity refers in part to degree of reliance on concrete referents in materials and solutions). Instructional direction should be managed to encourage increasingly independent and generalizable solutions.

For students not yet at--or just beginning to arrive at--formal thinking, projects need to be tied more closely to concrete (physical or external) referents. For example, first ask students to solve a problem in science (e.g., problem using principle of momentum) by asking for a solution step-by-step; ultimately, ask only for the final solution and require students to fill in appropriate intermediate steps. Or, to develop understanding of metaphor in poetry, begin with poetry actually written by children, where language is concrete and obvious, and move toward poetry where language is more abstract.

(d) A relative lack of differentiation between students' own and others'

points of view or between the subjective and objective in thought is evident at the early stages of formal thinking (Eason & Walmsley, 1980; Inhelder & Piaget, 1958). Students need practice in testing-out their ideas against the ideas of other students, in seeing both sides of an argument, and in recognizing good and poor arguments, as well as practice in evaluating the process by which they have completed one or the other of these kinds of tasks. For example, ask students to work in groups of 3 or 4 to develop a causal analysis of the process which led to the school gym being kept open after school for student use. Have the students record the pros, cons, and balance which led to the final solution for the problem; ask them to evaluate the solution process. Or, ask students to evaluate the causes of an historical conflict: (a) using conflicts experienced by students, develop pro and con reasons for both sides and develop "poor" reasons irrespective of side; (b) apply this scheme of analysis to an historical event.

Thinking About Thinking. As Keating (1980) points out, there are three ways in which the capacity to think about thoughts changes at adolescence: (a) metacognition or an individual's knowledge about the cognitive ability itself and the process which makes it function; (b) increase in introspection; and, (c) emergence of Piaget's "second-order thinking" or ability to perform operations on operations, e.g., develop rules about rules or hold, compare, and contrast dichotomous thoughts. The first of these three will be expanded briefly because of its importance at the transitional stage from concrete to formal thinking (Eason & Walmsley, 1980).

The construct is attributed to Flavell (1976): "Metacognition refers to one's knowledge concerning one's own cognitive processes and products or anything related to them ... For example, I am engaging in metacognition ... if I notice that I am having more trouble learning A than B; if it strikes me that

I should double-check C before accepting it as a fact; if it occurs to me that I had better scrutinize each and every alternative in any multiple-choice type task situation before deciding which is the best one; if I sense that I had better make a note of D because I might forget it; if I think to ask someone about E to see if I have it right ... Metacognition refers, among other things, to the active monitoring and consequent regulation ... of these processes in relation to the cognitive operations on which they bear ... (p. 232)."

Children do relatively little monitoring of their cognitive activities; they begin to learn and practice the processes. However, in early adolescence, as thinking moves from concrete to formal--as the possible, and the evaluation of possible possibilities, become predominant over the real in thought--the skill of metacognition is essential (A. Brown, 1978; A. Brown & DeLoache, 1978; A. Brown & Smiley, 1977; di Vesta et al., 1979; Eson & Walmsley, 1980; Flavell, 1979; Pace, 1981). Students need to know their own abilities to use metacognition skills (Oakland & Emmer, 1973). Metacognition has been identified as (a) assisting the transfer from concrete to formal thinking (A. E. Lawson & Wollman, 1976), (b) a facilitator in the transfer of problem solving techniques (M. J. Lawson & Fuloep, 1980), (c) a factor in the development of effective interpersonal skills (Elkind, 1980b), (d) an aid in developing memory encoding and recall skills (Hare & Smith, 1982), and (e) an aid in comprehension and in the development of language skills (Raphael et al., 1981; Templeton & Sulzby, 1980; Yussen et al., 1979).

Metacognition does not occur automatically in performance. The skills of metacognition--of monitoring cognitive activities--have to be learned. Use of metaphor has been suggested as one way to start students thinking about thinking (Meyrowitz, 1980; Samples, 1977; Winner et al., 1976).

Vygotsky describes self-monitoring as "inner speech", "functions" which

students internalize from the language that teachers use to mediate learning. For Vygotsky, "functions" appear on two levels in an individual's development: (a) first, on a social or interpsychological level, and (b) second, within the individual on an intrapsychological level. Vygotsky's theory would suggest that (a) concepts students are expected to learn, and (b) manner in which teachers manage the mediation of this learning are factors in individual student's development of metacognitive skills (Camperell, 1981; Vygotsky, 1978, 1962; Zender & Zender, 1974). The suggestion is reinforced by the finding that cultural difference appear to exist in attentional strategies and metacognition at the early adolescent age (P. H. Miller & Jordan, 1982; P. H. Miller & Weiss, 1981).

Evaluating the Level of Cognitive Development. Assessing formal operational thinking is not simple. In addition to the recognized general problems of measurement of developed abilities, there are several problems particular to this task. Individuals do not always operate at a level of formal operational thinking, even though they may have the capacity to do so. They usually perform to the level required for the task; if the task can be solved at the concrete operational level, the likelihood is that performance will be at that level (Karplus, 1977; Schweers, 1980). Assessment is complicated further by the fact that not all individuals perform at the formal operations level in all subjects. Failure to exhibit formal operations may mean that the subject content has not been conceptualized at that level, not that formal operations are lacking (Atwood, 1971; Brazee & Brazee, 1980; Elkind, 1980a; Heath, 1964; Piaget, 1972; Sund, 1976).

Evaluation of the thinking abilities and processes of holistic learners is approached differently from the evaluation of these skills in analytic learners. Evaluation techniques most frequently have been designed

to favor analytic learners. Cognitive preference examinations can be developed and used effectively to evaluate learning under different styles (Atwood, 1971; Heath, 1964). These evaluation processes provide information which identifies --in a meaningful context--curriculum related differences in cognitive style.

Further, it is not always easy to separate pseudo skills (e.g., conservation) from skills actually at the formal operational level (Pinard & Chassé, 1977). And, language skills--inadequate understanding of language or lack of language competence--can interfere with measurement of formal operations (Hutten-Tait et al., 1979).

Several innovative global techniques have been developed for evaluating learning style: cognitive mapping (Kusler, 1979; Cavanaugh, 1979), Learning Style System (Neumann et al., 1979), and Concept Level Matching (Leino, 1980). Most of these techniques are in an exploratory stage.

Performance Variance. Pervasive performance variance in the development of Piagetian thinking processes is accounted for by individual variability in information processing modes and skills. Current research focuses on three areas: (a) cognitive processing differences, (b) task analysis, and (c) Pascual-Leone's neo-Piagetian model of an organizing "executive function" (Keating, 1980). Recent research on the human brain suggests that some cognitive processes of the brain may underlie cognitive style. For example, Wittrock (1978b) reports a study in which three information processing strategies--analytic versus global, part versus whole scanners, and verbal process versus imagery were compared to see which explained the difference in accuracy in problem solving between youngsters identified as reflective and those identified as impulsive. The first--analytic versus global--was responsible. An educational implication of these findings is that impulsive students, who are found relatively more frequently among lower socio-economic groups, are not

necessarily inferior to reflective students in problem solving ability. But, learning for these students will be difficult unless instruction can be so managed as to provide a match between the students' global information processing strategy and the organization of curricula and instructional tasks--using a structure in addition to the predominant analytic/linear approach.

Personalized Education

or meeting individual needs in the classroom by reflecting the learning styles of the students in the instructional environment (Davidman, 1981).

Five important generalizations about the early adolescent learner can be made from this selected review of the literature--all five reflect heterogeneity as characteristic of this age.

(a) Tremendous variability can be observed in biological development, both in terms of level of maturation and of quality and idiosyncrasy of this development across the age span. One behavioral effect is shortened attention span.

(b) The majority of early adolescents have the competence to move from concrete to formal operational thinking; many are in transition from concrete to formal operational thinking.

(c) Learning styles vary widely across early adolescence; cognitive processes of the brain appear to affect cognitive style, a key component of learning style.

(d) Learning is a constructive process which is the responsibility of the learner--the whole person: developed abilities, motives, needs, interests, ...

(e) Information processing strategies--modes of perceiving and coding reality--vary among individuals.

Two important generalizations about cognitive developmental processes at early adolescence can be made.

(a) While early adolescent learners may possess formal operational competence, they need to learn and to practice the techniques of formal operational thinking; the learning and performance of formal operational thinking is dependent upon an adequate base of concrete experiences.

(b) Efficient and effective formal operational thinkers are those who have developed an ability to monitor cognitive activities; metacognitive skills.

Six content-organizational suggestions related to curriculum for the early adolescent learner are made based on the review and generalizations.

(a) Curricula be structured to meet the needs of the holistic as well as the analytic learner.

(b) Curricula be structured so the learner becomes habituated to the use of verbal and visual processing modes.

(c) Curricula be structured to provide varied and appropriate concrete (physical or external) experiences for the learner.

(d) Curricula be structured to provide for continuous process learning, at least in English, mathematics, and science. Continuous process learning is a modified form of nongraded curriculum organization within subject areas. The approach frequently makes use of a subject area (vertical) core (Vars, 1967).

(e) Curricula be structured to provide for the teaching of the language of the subject areas rather than the separate teaching of reading (A. E. Lawson et al., 1975).

(f) Curricula be structured to meet the needs and interests of the early adolescent; to foster the development of a motive to achieve in school.

Career education and guidance services--recognized as essential for this age group--should be an integral part of the middle school curriculum (Almer, 1971; Batchelder & Cole, 1980; Bergland & Lundquist, 1975; Campbell et al. 1969; Hill, 1979; Musholt, 1977; Otte & Sharpe, 1979; Pentecoste, 1975; W. Smith, 1980; Sweat, 1979; Tobin et al. 1977; Winter & Schmidt, 1974).

Management of Learning

"The Piagetian forms do not tell us how or what to teach. They do tell us, once we know what we want to instruct young people in, how to do it most efficiently and effectively (Elkind, 1980a, p. 293)." And, as previously stated, Piaget and others note that learning is the active constructive task of the learner. Teaching, in response, has to be more than reinforcement of correct responses but rather a management task of organizing and relating new information to learners' previous experiences, stimulating them to construct their own representations--verbal and imaginal--for what each is meeting (Wittrock, 1977, p. 127).

Teachers are managers of instruction; they facilitate and monitor constructive processes of learning (Kosofsky & Holliday, 1973; Langer & Rosenberg, 1981; Wittrock, 1978b). As managers, they possess a quality of flexibility (Schoo, 1974) that enables them to provide material in such a way that it is "... relatable to ideas that exist within the cognitive structure of the particular learner (Ausubel, 1980, p. 236)."

One management approach, appropriate to facilitating the transition from concrete to formal thinking is the "project method" (Gruber, 1973; Voyat, 1973). "Projects" are problems or tasks which require exploratory (mental or physical) manipulation. They are designed to allow the individual to experience the conflict between constructs (actual or mental events) and to plan and execute a solution to the conflict. In the early stages of transition from concrete to formal thinking, projects rely heavily on physical--concrete--manipulation. But projects should be designed and managed to encourage increasingly independent and generalizable solutions. Projects also should be designed to give the learners direct practice in testing their ideas against those of others, both physically present and ideationally present. In project designs, subtasks

should be included which call on cognitive monitoring skills. The purpose of such subtasks would be to give the learners practice in the development of metacognitive abilities.

Practica in the Management of Learning

McLaughlin (1976) notes that if anything constructive occurs in the schooling of the early adolescent, it will be inaugurated by principals and teachers who understand the characteristics of the group and its needs. Teachers recognize this; many have stated a desire for inservice courses dealing with early adolescent characteristics and needs (Underwood & Underwood, 1977). Fielder (1978, p. 325) states that teachers who plan to work with early adolescents require: "... (1) A thorough knowledge of the developmental growth characteristics of boys and girls in the middle school. (2) Knowledge of teaching/learning strategies that are appropriate to the needs of the students in the middle school. (3) Time and energy to learn, plan, and implement the knowledge called for in (1) and (2), above. (4) Motivation which comes from perceived rewards that one can confidently expect to accrue as a result of positive and effective participation in a program designed to meet the middle school challenge." Fielder's position is not unique; see, for example, Staffing the Middle School (National Middle School Resource Center, n.d.).

Six practica are suggested for continuing professional education of teachers of the early adolescent. Four assumptions underlie these suggestions: (a) Teachers cannot be expected to complete in-service work of any consequence on their own time, especially considering the geometric progression of both the complexity and quantity of knowledge related to learning. (b) Staff development activities should be oriented toward application. (c) Teachers and administrators should participate together in staff development activities. (d) Provision should be made for on-the-job supervision of teachers and administrators in staff development courses.

The practica are viewed as sessions leading to the development of self-supervision techniques. The approach of Hunt which, recognizing the continuous

changing nature of the teaching/learning transaction in which the student is the active participant, builds on existing teacher knowledge to direct teachers in the development of skills of continuing evaluation--skills which enable the teacher to "read" (or try to understand the student), then "flex" (or adapt management techniques to the needs of the student) who in turn reciprocates (Hunt, 1981; 1980; 1979; 1978; 1976; 1975; Hunt & Joyce, 1967). Hunt's approach evolved from his variation of Lewin's $B = f(P \cdot E)$, namely, $E: P \rightarrow B$, or an environment (E) directed toward a person (P) produces a behavior (B). Training agents--teachers--develop capacities to radiate a wide variety of environments, to select from this variety a specific environment to be radiated toward a particular person or group with the aim of producing a particular behavioral outcome, and to shift from one environment to another under appropriate circumstances (Hunt, 1966).

The "read/flex"--continual diagnostic--approach is particularly suited to the early adolescent age where the tremendous inter- and intraindividual developmental differences and changes as well as frequent variability of behaviors demand not only close monitoring for effective management of learning but an instructional environment which allows each learner to participate at his/her present cognitive level and at the same time interact with learners at other cognitive levels (Brazee & Brazee, 1980; Huber, 1978; Ryman, 1977: Teacher Preparation, n.d.).

Six Practica in the Management of Learning.

1. Providing for the Analytic and the Holistic Learner in the Classroom.
 - a. Identifying the analytic and the holistic learner.
 - b. Structure of learning activities.
 - c. Varieties of instructional materials.
 - d. Evaluating performances of analytic and holistic learners.

2. Use of Imagery and Verbal Stimuli to Maximize Learning.

Directing students in the use of both imagery and verbalization to maximize encoding and recall of stimulus material.

3. Cognitive Monitoring Strategies for the Learner.

Strategies enabling the learner to monitor

- a. the process by which he/she completed a learning task,
- b. the outcome of the learning activity,
- c. the effectiveness of the process used to complete a learning task,
- d. the transfer of the process to similar learning tasks.

4. Improving Skills in the Management of Learning.

- a. "Reading" and "flexing" to the individual student.
- b. "Informed speculation" or continuous evaluation of the student in the management of learning.

5. Techniques for Encouraging Transition from Concrete to Formal Thinking.

- a. Project method.
- b. Planning multiple and diverse concrete experiences.
- c. Interest as a factor in thought.
- d. Teaching the language of the subject.

6. Team Teaching for Continuous Progress Learning.

- a. Vertical--within subject--teams.
- b. Horizontal--across subject--teams.

Preprofessional Preparation of Teachers of the Early Adolescent

A national assessment of the effects of middle school teacher certification has indicated that teachers possessing certificates are more positive with regard to job satisfaction and attitudes toward middle schools, and more proficient in educational competencies emphasized in the middle school (Gillan, 1978). Specialized preparation for middle grades teachers is recognized as important. The middle grades teacher is described as a flexible, warm, good humored individual who has a functional understanding of the early adolescent and of the teaching subject and fluency in techniques of managing instruction (Bertos & Smith, 1980; Lawrence, 1971).

The following suggested framework for a program for the preparation of teachers of the early adolescent is based on the literature reviewed above and on a review of existing middle school teacher preparation programs and recommendations for such programs, as well as selected middle school curricula. The material on existing programs, recommendations, and curricula was supplied by the National Middle School Resource Center.

Framework for preprofessional preparation: three-pronged framework which includes

- a. preparation in the subject area to be taught--approximately 30 credits, including some specially developed subject area courses;
- b. preparation in the professional field--approximately 30 to 40 credits, including courses in early adolescent development, curriculum, methods, evaluation, teaching language in the subject area, guidance techniques, and an hierarchical set of supervised field experiences--from observation through teaching practicum--integrated with the courses; and
- c. screening in two areas--language ability and flexibility--for the purpose of personalizing preprofessional preparation.

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